PATENT ABSTRACTS OF JAPAN

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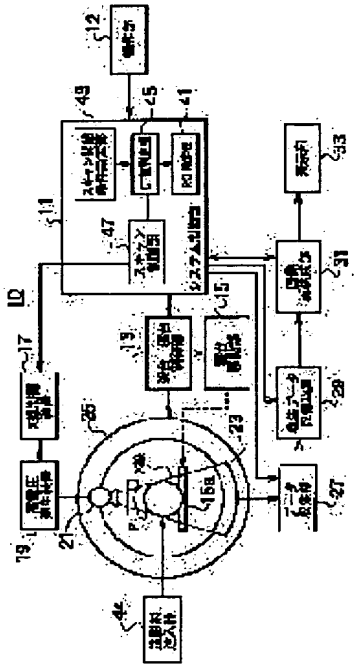
(54) CT APPARATUS



(57)Abstract:
PROBLEM TO BE SOLVED: To collect inspection data for an object to be examined at an optimum contrasting timing by monitoring contrasting condition of the whole organs and monitoring different blood vessel groups.
SOLUTION: An ROI designating part 41 designates a plurality of concerned regions of an object P to be examined in the three-dimensional region based on the three-dimensional data of the object P to be examined and a scan starting condition setting part 43 sets a scan starting condition for starting an inspection scan and a CT value judging part 45 judges whether CT values in a plurality of concerned regions designated by the ROI designating part 41 after a contrasting agent is poured into the object P to be examined reach the scan starting condition set by the scan starting condition setting part 43. Then, a scan control part 47 starts the inspection scan of the object P to be examined when the CT values in a plurality of the concerned regions reach the scan starting condition.

CLAIMS

[Claim(s)]
[Claim 1] The X-ray CT scanner characterized by to have an assignment means specify two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte, a monitor means supervise CT value change of two or more of said areas of interest specified by said assignment means after pouring a contrast medium into said analyte, and the scanning control means that make the inspection scan of said analyte start based on CT value change of two or more of said areas of interest supervised by this monitor means.
[Claim 2] It is the X-ray CT scanner according to claim 1 which judges whether said monitor means reached the scanning start condition to which it was set beforehand for the CT valve of two or more of said areas of interest specified by said assignment means to start said inspection scan, and is characterized by said scanning control means making the inspection scan of said analyte start when the CT valve of two or more of said areas of interest reaches said scanning start condition.
[Claim 3] Said three-dimension data are an X-ray CT scanner according to claim 1 characterized by being data obtained using the data or the flat-surface detector obtained using the two-dimensional detector by which two or more trains array was carried out in the helical data obtained by helical scan or the slice direction of said analyte.
[Claim 4] Said assignment means is an X-ray CT scanner according to claim 1 characterized by extracting a specific part and specifying said two or more areas of interest as the extracted specific part by comparing with the threshold which was able to define the CT valve of said three-dimension data beforehand.
[Claim 5] Said monitor means is an X-ray CT scanner according to claim 2 characterized by judging whether all the CT valves of two or more of said areas of interest exceeded the threshold defined beforehand as said scanning start condition.
[Claim 6] When said scanning start condition is set up according to the individual for every area of interest, said monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of interest was reached. Said scanning control means The X-ray CT scanner according to claim 2 characterized by making the inspection scan of said analyte start when the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest.
[Claim 7] The slit which is prepared between X line source and said analyte, and has the movable X-ray shield of two sheets along the slice direction of said analyte, The slit control means which controls width of face between X-ray shields of two sheets of said slit to carry out exposure of the X-ray from said X line source only to two or more slices corresponding to said two or more areas of interest while said monitor means is supervising CT value change, The X-ray CT scanner according to claim 1 characterized by preparation ******.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About a whole body X-ray CT scanner, especially this invention pours a contrast medium into the interior of analyte, and relates to the X-ray CT scanner which scans analyte to the optimal imaging timing.
[0002]
[Description of the Prior Art] Conventionally, in order to make ****** clear in an X-ray CT scanner, a contrast medium is poured into the interior of analyte, and the real PUREPPU scan which scans analyte to the optimal imaging timing is known.
[0003] In this real PUREPPU scan, first, 1 cross-section image of analyte is used, areas of interest (it

is hereafter called ROI for short.), such as the interior of this 1 cross section, for example, a main artery etc., are specified, and the CT valve of that ROI is supervised.
[0004] And the CT valve of the ROI goes up with the contrast medium poured into the interior of analyte, and when a threshold with the CT valve is reached, it checks that the ROI has dyed enough with the contrast medium. Then, collection of the inspection data of analyte is started. Therefore, since it can scan to the optimal imaging timing, it is very effective in prehension of the positive imaging timing which does not depend on analyte.
[0005]
[Problem(s) to be Solved by the Invention] However, if it was in the conventional real PUREPPU scan, since the CT valve of ROI only in one cross section of analyte was supervised, it was unobservable whether the whole field of an organ to observe dyed best with the contrast medium.
[0006] Moreover, when there were not the optimal arterial blood tubing for the exactly same cross-section image and a portal vein blood vessel for example, to observe an artery layer and a portal vein layer, it was difficult to supervise both arterial blood tubing and portal vein blood vessel to coincidence.
[0007] The purpose of this invention is by supervising the monitor of the imaging condition of the whole organ, and a different imaging condition of a blood vessel group to offer the X-ray CT scanner which can collect the inspection data of analyte to the optimal imaging timing.
[0008]
[Means for Solving the Problem] This invention was considered as the following configurations, in order to solve said technical problem. This invention is characterized by to have an assignment means specify two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte, a monitor means supervise CT value change of two or more of said areas of interest specified by said assignment means after pouring a contrast medium into said analyte, and the scanning control means that make the inspection scan of said analyte start based on CT value change of two or more of said areas of interest supervised by this monitor means.
[0009] When an assignment means specifies two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte according to this invention, a monitor means supervises CT value change of two or more areas of interest specified by the assignment means, after pouring a contrast medium into analyte, and a scanning control means makes the inspection scan of analyte start based on CT value change of two or more areas of interest supervised by the monitor means. That is, since two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.
[0010] Moreover, it judges whether said monitor means reached the scanning start condition to which it was set beforehand for the CT valve of two or more of said areas of interest specified by said assignment means to start said inspection scan, and said scanning control means is characterized by making the inspection scan of said analyte start, when the CT valve of two or more of said areas of interest reaches said scanning start condition.
[0011] Since it judges whether the monitor means reached the scanning start condition to which it was set beforehand for the CT valve of two or more areas of interest specified by the assignment means to start an inspection scan, and a scanning control means makes the inspection scan of analyte start according to this invention when the CT valve of two or more areas of interest reaches to a scanning start condition, it is collectable in the inspection data of analyte with the optimal imaging timing to the whole organ or a different blood vessel group.
[0012] Moreover, when said scanning start condition is set up according to the individual for every area of interest, said monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of interest was reached. Said scanning control means When the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, it is characterized by making the inspection scan of said analyte start.
[0013] According to this invention, when the scanning start condition is set up according to the

individual for every area of interest, a monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of interest was reached. A scanning control means Since the inspection scan of analyte is made to start when the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, the inspection data of analyte are collectable to the optimal imaging timing for every area of interest.
[0014] Moreover, it is prepared between X line source and said analyte, and is characterized by having the slit which has the movable X-ray shield of two sheets along the slice direction of said analyte, and the slit control means which controls width of face between X-ray shields of two sheets of said slit to carry out exposure of the X-ray from said X line source only to two or more slices corresponding to said two or more areas of interest while said monitor means is supervising CT value change.
[0015] While the monitor means is supervising CT value change according to this invention, since a slit control means controls width of face between X-ray shields of two sheets of a slit to carry out exposure of the X-ray from X line source only to two or more slices corresponding to two or more areas of interest, it can lessen the amount of exposures of the X-ray to analyte.
[0016]
[Embodiment of the Invention] Hereafter, the gestalt of operation of the X-ray CT scanner of this invention is explained to a detail with reference to a drawing.
[0017] <Gestalt of the 1st operation> drawing 1 is the system configuration Fig. showing the outline configuration of the 1st of the X-ray CT scanner of the gestalt of operation of this invention. In drawing 1 , X-ray CT scanner 10 of the gestalt of the 1st operation has the system control section 11, a control unit 12, a stand and a berth control section 13, the berth migration section 15, the X-ray control device 17, a high-voltage transformer assembly 19, the X-ray beam generation source 21, a detector 23, the rotation stand 25, the data collection section 27, the collection data storage 29, the image reconstruction section 31, and a display 33. This X-ray CT scanner 10 carries out exposure of the X-ray beam, rotating the X-ray beam generation source 21 around Analyte P.
[0018] Control units 12 are a mouse, a keyboard, etc. and input various kinds of information. The system control section 11 consists of central processing units (CPU) etc., and is outputted to a stand and the berth control section 13 by making into a stand and a berth control signal slice thickness inputted from the control unit 12, rotational speed, berth movement magnitude, etc. The system control section 11 outputs the X-ray beam generating control signal which controls X-ray beam generating to the X-ray control unit 17.
[0019] The system control section 11 outputs the detection control signal which shows the timing of detection of an X-ray beam to the data collection section 27. The system control section 11 outputs the data collection control signal for data collection to the data collection section 27.
[0020] A stand and the berth control section 13 output a berth migration signal to the berth migration section 15 while rotating the rotation stand 25 based on the stand and berth control signal which were outputted by the system control section 11.
[0021] The X-ray control device 17 controls the timing of high-voltage generating by the high-voltage transformer assembly 19 based on the X-ray beam generating control signal outputted by the system control section 11. A high-voltage transformer assembly 19 supplies the high voltage for carrying out exposure of the X-ray beam to the X-ray beam generation source 21 according to the control signal from the X-ray control section 17.
[0022] With the high voltage supplied from the high-voltage transformer assembly 19, the X-ray beam generation source 21 turns to analyte the flabellate form X-ray beam which had thickness in the slice direction, and it carries out exposure from many. Exposure of the detector 23 is carried out from the X-ray beam generation source 21, and it detects the X-ray beam which penetrated analyte.
[0023] Drawing 2 (a) is drawing which expressed the detector 23 in three dimension. A detector 23 consists of a two-dimensional detector by which has the sensing element of many channels and two or more arrays were carried out in the slice direction. About each train, the sensing element of about 1,000 channels is arranged in the shape of radii considering the focus of the X-ray beam generation source 21 as a core like the detector for single-slice CTs of drawing 2 (b).
[0024] The rotation stand 25 holds the X-ray beam generation source 21 and a detector 23. The

rotation stand 25 rotates by the stand rolling mechanism which is not illustrated centering on the revolving shaft which passes along the midpoint of the X-ray beam generation source 21 and a detector 23. In addition, while the X-ray beam generation source 21 and a detector 23 rotate the perimeter of analyte one time, it calls it one scanning actuation to collect the projection data of two or more slices (two or more cross sections) of analyte.

[0025] The data collection section 27 collects and outputs the projection data of two or more slices of analyte to coincidence based on the data collection control signal outputted by the system control section 11. The collection data storage 29 memorizes the projection data of two or more slices of the analyte collected by the data collection section 27.

[0026] The image reconstruction section 31 reconfigurates two or more fault images of analyte to coincidence based on the projection data of two or more slices memorized by the collection data storage 29. A display 33 displays on a monitor two or more fault images of the analyte reconfigurated in the image reconstruction section 31 on coincidence.

[0027] Moreover, the system control section 11 has the ROI specification part 41, the scanning start condition setting section 43, the CT valve judging section 45, and the scanning control section 47. The ROI specification part 41 specifies two or more ROIs in the three-dimension data based on two or more fault images of the analyte obtained in the image reconstruction section 31.

[0028] The scanning start condition setting section 43 sets up the scanning start condition for stopping the real PUREPPU scan which pours the contrast medium from the contrast-medium transfer pipet 44 into Analyte P, and is carried out, and usually starting a scan.

[0029] The CT valve judging section 45 judges whether the scanning start condition to which the CT valve of two or more ROIs specified in the ROI setting section 41 was set in the scanning start condition setting section 43 was filled.

[0030] The scanning control section 47 makes a scan usually start, when the CT valve of two or more ROIs fills a scanning start condition. Moreover, the scanning control section 47 performs X-ray exposure of a low dose with a real PUREPPU scan, and usually performs X-ray exposure of many dosage comparatively with a scan.

[0031] Next, the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 1st operation constituted in this way is explained, referring to the flow chart of drawing 3 R> 3.

[0032] First, by rotating the X-ray beam generation source 21 and the detector 23 for a multi-slice around Analyte P, the scan for ROI assignment is performed and the three-dimension data (volume data) of Analyte P are collected (step S11). This three-dimension data is volume data based on two or more fault images reconfigurated in the image reconstruction section 431.

[0033] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve in the three-dimension data collected at step S11. For example, as shown in drawing 4 , R1, R2, and R3 are specified as three ROIs in the organ 51 of the three-dimension data 50. Each of R1, R2, and R3 is covering two or more cross sections. Three ROIs are specified using a mouse etc. on the screen of a display 33 in fact.

[0034] In addition, about the specification method of ROI, the following two approaches can be illustrated, for example. The 1st approach sets up suitable window width to the CT valve of three-dimension data, and is an approach of specifying ROI using 3D image included in the set-up window width which extracted only the blood vessel section, for example. The 2nd approach is an approach of performing differential processing etc. to the CT valve of three-dimension data, performing edge detection, extracting the profile of only a certain organ, and specifying ROI.

[0035] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S13). As this scanning start condition, conditions as shown in drawing 5 (a) and drawing 5 (b) can be illustrated, for example.

[0036] In the example shown in drawing 5 (a), when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 into a threshold and a CT valve [in / for a CT valve / in / for the CT valve in R1 / CT1 and R2 / CT2 and R3] is set to CT3, let CT1>X0, CT2>X0, and CT3>X0 be scanning start conditions. That is, it is contingent [on whether all of each of CT1, CT2, and CT3 exceeded the threshold X0].

[0037] In the example shown in drawing 5 (b), when you make an axis of ordinate into a CT valve,

you make an axis of abscissa into time amount and X1 is made into a threshold, let 1(CT12+CT22+CT32)/2>X1 be a scanning start condition. That is, it is contingent [on whether the square root of total of the square of each value of CT1 CT2, and CT3 exceeded the threshold X1].
[0038] In addition, you may be scanning start conditions other than a scanning start condition as shown in drawing 5 (a) and drawing 5 (b), and a suitable identifier is added, the scanning start condition is registered beforehand, and you may set up by reading the scanning start condition.
[0039] Next, after starting impregnation inside [of the contrast medium from the contrast-medium transfer pipet 44] analyte P (step S15), the scanning control section 47 sends out a low-dose control signal to the X-ray control unit 17, and makes a real PUREPPU scan carry out (step S17). With this real PUREPPU scan, the tube electric current mA of the X-ray beam generation source 21 is lowered rather than a scan, it can consider as a low dose or the amount of exposures to Analyte P can usually be lessened by using a special X-ray filter.
[0040] In addition, the scanning control section 47 may be synchronized with impregnation of the contrast medium from the contrast-medium transfer pipet 44, and may make a real PUREPPU scan start. In this case, when a contrast medium is poured in from the contrast-medium transfer pipet 44, the impregnation signal which shows impregnation of a contrast medium is sent out to the scanning control section 47, and the scanning control section 47 makes it synchronize with that impregnation signal, and should just make a real PUREPPU scan start. If it does in this way, a real PUREPPU scan can be certainly carried out to suitable timing.
[0041] Moreover, the scanning control section 47 may carry out exposure of the X-ray intermittently for a while by sending out an intermittent signal to the X-ray control unit 17. If it does in this way, the amount of exposures to Analyte P can be lessened.
[0042] Thus, the CT valve judging section 45 supervises whether the CT valve of two or more specified ROIs reached the scanning start condition (step S19). For example, in the example shown in drawing 5 (a), all of each CT valve of R1, R2, and R3 reach a threshold X0 in time of day t1. Moreover, in the example shown in drawing 5 (b), the square root of total of the square of each CT valve of R1, R2, and R3 reaches a threshold X1 in time of day t2.
[0043] Furthermore, when the CT valve of two or more specified ROIs reaches a scanning start condition, the scanning control section 47 carries out the usual scan of Analyte P (step S21). In this case, exposure of comparatively a lot of X-rays is carried out to Analyte P, and inspection data are collected.
[0044] Thus, two or more ROIs are specified using three-dimension data, and since X dosage is raised and a scan is usually started when the CT valve of two or more specified ROIs reaches a scanning start condition, the whole organ can collect inspection data to the timing which dyed best with the contrast medium. For this reason, ****** etc. can be made clearer.
[0045] In addition, drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 6 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 1st operation to drawing 7 is shown.
[0046] As shown in drawing 6 (a), if R1 is specified in organ 51a of one cross section S1 (one slice) and the CT valve of Rspecified 1 reaches a threshold X0 at time of day t3, by the conventional approach, a scan will usually be started. Since only one cross section is observed by this approach, at time of day t3, the CT valve of R2 is not ****(ed) to a threshold X0 so that drawing 7 (b) may also show. For this reason, the whole organ was collecting inspection data to the timing which does not fully dye.
[0047] On the other hand, as shown in drawing 7 (a), by the approach of the gestalt the 1st operation, R1, R2, and R3 are specified in organ 51b covering two or more cross sections, and a scan is usually started at the time of day t4 when all the CT valves of R1, R2, and R3 reached the threshold X0. For this reason, the whole organ can collect inspection data to the timing which dyed best with the contrast medium.
[0048] The X-ray CT scanner of <the gestalt of the 2nd operation>, next the gestalt of operation of the 2nd of this invention is explained. The X-ray CT scanner of the gestalt of the 2nd operation is characterized by collecting inspection data to the optimal imaging timing to each blood vessel group of a different blood vessel group. The three-dimension real PUREPPU processing by the X-ray CT

scanner of the gestalt of the 2nd operation is explained referring to the flow chart of drawing 8 .
[0049] First, the scan for ROI assignment is performed and the three-dimension data of Analyte P are collected (step S31).
[0050] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve out of collected three-dimension data. For example, as shown in drawing 9 , R4 is specified in the main artery 55 of the three-dimension data 50, and R5 is specified in an organ 53.
[0051] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S33). As a scanning start condition, conditions as shown in drawing 10 can be illustrated, for example.
[0052] In the example shown in drawing 10 , when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 and X1 into a threshold and a CT valve [in / for the CT valve in R4 / CT4 and R5] is set to CT5, make CT4>X0 into the 1st scan start condition, and let CT5>X1 be the 2nd scan start condition. In addition, it is good also considering |CT4-CT5|<X2 as the 2nd scan start condition.
[0053] the [next, / for R4 as which the scanning control section 47 was specified after starting impregnation of the contrast medium from the contrast-medium transfer pipet 44 to the interior of analyte P (step S35)] -- 1 real PUREPPU scan is made to carry out (step S37)
[0054] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 4 reached the 1st scan start condition (step S39). As the CT valve of Rspecified 4 shows drawing 10 , when the 1st scan start condition is reached at time of day t5, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 1st inspection data (step S41).
[0055] the [next, / for R5 as which the scanning control section 47 was specified] -- 2 real PUREPPU scan is made to carry out (step S43)
[0056] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 5 reached the 2nd scan start condition (step S45). As the CT valve of Rspecified 5 shows drawing 10 , when the 2nd scan start condition is reached at time of day t6, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 2nd inspection data (step S47). In addition, only a count [need / step S43 to the step S47 / to be processed] is performed repeatedly.
[0057] Thus, since it judges whether the scanning start condition to which ROI was specified as each of two blood vessels, the scanning start condition was set up according to the individual for every ROI, and the CT valve of ROI was set to the ROI was reached, inspection data are collectable to two optimal different imaging timing.
[0058] In addition, you may carry out also in this case by synchronizing scanning initiation timing with the impregnation timing of the contrast medium from the contrast-medium transfer pipet 44, and exposure of the X-ray may be carried out intermittently.
[0059] Drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 11 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 2nd operation to drawing 12 is shown.
[0060] As shown in drawing 11 (a), if R4 (main artery) is specified in one cross section S2 (one slice) and the CT valve of Rspecified 4 reaches a threshold X0 at time of day t7, by the conventional approach, a scan (the 1st scan) will usually be started. By this approach, it is the optimal imaging timing for an artery layer. However, since only R4 is observed, the optimal imaging timing of a balanced layer or a portal vein layer is not known. For this reason, the imaging timing of a balanced layer or a portal vein layer was dependent on a way person's can, and experience. In addition, in drawing 11 (b), the time amount td from the end time of an artery layer to the start time of a balanced layer is the time amount depending on a way person's can, and experience.
[0061] On the other hand, as shown in drawing 12 (a), by the approach of the gestalt the 2nd operation, R4 (main artery) is specified in a blood vessel 55, R5 (portal vein) is specified in a blood vessel 53, when the CT valve of R4 reaches the 1st scan start condition at time of day t7, the 1st scan is started, and when the CT valve of R5 reaches the 2nd scan start condition at time of day t9, the 2nd scan is started. Therefore, inspection data are collectable to the imaging timing optimal about each of an artery layer, a portal vein layer, and a balanced layer.
[0062] The X-ray CT scanner of <the gestalt of the 3rd operation>, next the gestalt of operation of the

3rd of this invention is explained. Drawing 13 is the configuration block Fig. of the principal part of the X-ray CT scanner of the gestalt of the 3rd operation. This X-ray CT scanner is further characterized by having a slit 61 and the slit control section 63, as shown in drawing 13 .

[0063] A slit 61 is formed between the X-ray beam generation source 21 and Analyte P, and has the movable X-ray shield of two sheets along the slice direction. The slit control section 63 controls width of face between X-ray shields of two sheets of a slit 61 based on two or more ROIs specified with the ROI specification part 41 in system control section 11a to carry out exposure of the X-ray only to two or more slices corresponding to two or more of these ROIs.

[0064] As shown in drawing 13 , according to the constituted X-ray CT scanner, thus, the slit control section 63 In order [corresponding to R1 and R2 which were specified] to control width of face between X-ray shields of two sheets of a slit 61 to carry out exposure of X-ray FB only, for example to three slices, Since exposure of the X-ray is not carried out to the remaining parts of organs 57 other than R1 and R2, the unnecessary amount of exposures to Analyte P can be lessened.

[0065] In addition, this invention is not limited to the X-ray CT scanner of the gestalt of the 1st mentioned above thru/or the 3rd operation. With the gestalt of the 1st thru/or the 3rd operation, although the detector 23 for a multi-slice was used, as shown in drawing 14 , three-dimension data may be collected using the flat-surface detector 65 by rotating the X-ray beam generation source 21 and the flat-surface detector 65 around Analyte P, for example.

[0066] Moreover, using detector 23a for a single slice as shown in drawing 2 (b), by moving berth 15a in the slice direction at a predetermined rate by the berth migration section 15, helical scan may be performed and the helical data obtained by helical scan, i.e., the three-dimension data of analyte, may be collected.

[0067]

[Effect of the Invention] Since according to this invention two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.

TECHNICAL FIELD

[Field of the Invention] About a whole body X-ray CT scanner, especially this invention pours a contrast medium into the interior of analyte, and relates to the X-ray CT scanner which scans analyte to the optimal imaging timing.

PRIOR ART

[Description of the Prior Art] Conventionally, in order to make ****** clear in an X-ray CT scanner, a contrast medium is poured into the interior of analyte, and the real PUREPPU scan which scans analyte to the optimal imaging timing is known.

[0003] In this real PUREPPU scan, first, 1 cross-section image of analyte is used, areas of interest (it is hereafter called ROI for short.), such as the interior of this 1 cross section, for example, a main artery etc., are specified, and the CT valve of that ROI is supervised.

[0004] And the CT valve of the ROI goes up with the contrast medium poured into the interior of analyte, and when a threshold with the CT valve is reached, it checks that the ROI has dyed enough with the contrast medium. Then, collection of the inspection data of analyte is started. Therefore, since it can scan to the optimal imaging timing, it is very effective in prehension of the positive imaging timing which does not depend on analyte.

EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, if it was in the conventional real PUREPPU scan, since the CT valve of ROI only in one cross section of analyte was supervised, it was unobservable whether the whole field of an organ to observe dyed best with the contrast medium.
[0006] Moreover, when there were not the optimal arterial blood tubing for the exactly same cross-section image and a portal vein blood vessel for example, to observe an artery layer and a portal vein layer, it was difficult to supervise both arterial blood tubing and portal vein blood vessel to coincidence.
[0007] The purpose of this invention is by supervising the monitor of the imaging condition of the whole organ, and a different imaging condition of a blood vessel group to offer the X-ray CT scanner which can collect the inspection data of analyte to the optimal imaging timing.

MEANS

[Means for Solving the Problem] This invention was considered as the following configurations, in order to solve said technical problem. This invention is characterized by to have an assignment means specify two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte, a monitor means supervise CT value change of two or more of said areas of interest specified by said assignment means after pouring a contrast medium into said analyte, and the scanning control means that make the inspection scan of said analyte start based on CT value change of two or more of said areas of interest supervised by this monitor means.
[0009] When an assignment means specifies two or more areas of interest of analyte in the three-dimension field based on the three-dimension data of analyte according to this invention, a monitor means supervises CT value change of two or more areas of interest specified by the assignment means, after pouring a contrast medium into analyte, and a scanning control means makes the inspection scan of analyte start based on CT value change of two or more areas of interest supervised by the monitor means. That is, since two or more areas of interest by three-dimension data are specified and the monitor of the imaging condition of the whole organ and a different imaging condition of a blood vessel group are supervised, the inspection data of analyte are collectable to the optimal imaging timing to the whole organ or a different blood vessel group.
[0010] Moreover, it judges whether said monitor means reached the scanning start condition to which it was set beforehand for the CT valve of two or more of said areas of interest specified by said assignment means to start said inspection scan, and said scanning control means is characterized by making the inspection scan of said analyte start, when the CT valve of two or more of said areas of interest reaches said scanning start condition.
[0011] Since it judges whether the monitor means reached the scanning start condition to which it was set beforehand for the CT valve of two or more areas of interest specified by the assignment means to start an inspection scan, and a scanning control means makes the inspection scan of analyte start according to this invention when the CT valve of two or more areas of interest reaches to a scanning start condition, it is collectable in the inspection data of analyte with the optimal imaging timing to the whole organ or a different blood vessel group.
[0012] Moreover, when said scanning start condition is set up according to the individual for every area of interest, said monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of

interest was reached. Said scanning control means When the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, it is characterized by making the inspection scan of said analyte start.
[0013] According to this invention, when the scanning start condition is set up according to the individual for every area of interest, a monitor means It judges whether the scanning start condition by which the CT valve of the area of interest was set as the area of interest according to the individual for every area of interest was reached. A scanning control means Since the inspection scan of analyte is made to start when the CT valve of the area of interest reaches the scanning start condition set as the area of interest according to the individual for every area of interest, the inspection data of analyte are collectable to the optimal imaging timing for every area of interest.
[0014] Moreover, it is prepared between X line source and said analyte, and is characterized by having the slit which has the movable X-ray shield of two sheets along the slice direction of said analyte, and the slit control means which controls width of face between X-ray shields of two sheets of said slit to carry out exposure of the X-ray from said X line source only to two or more slices corresponding to said two or more areas of interest while said monitor means is supervising CT value change.
[0015] While the monitor means is supervising CT value change according to this invention, since a slit control means controls width of face between X-ray shields of two sheets of a slit to carry out exposure of the X-ray from X line source only to two or more slices corresponding to two or more areas of interest, it can lessen the amount of exposures of the X-ray to analyte.
[0016]
[Embodiment of the Invention] Hereafter, the gestalt of operation of the X-ray CT scanner of this invention is explained to a detail with reference to a drawing.
[0017] <Gestalt of the 1st operation> drawing 1 is the system configuration Fig. showing the outline configuration of the 1st of the X-ray CT scanner of the gestalt of operation of this invention. In drawing 1 , X-ray CT scanner 10 of the gestalt of the 1st operation has the system control section 11, a control unit 12, a stand and a berth control section 13, the berth migration section 15, the X-ray control device 17, a high-voltage transformer assembly 19, the X-ray beam generation source 21, a detector 23, the rotation stand 25, the data collection section 27, the collection data storage 29, the image reconstruction section 31, and a display 33. This X-ray CT scanner 10 carries out exposure of the X-ray beam, rotating the X-ray beam generation source 21 around Analyte P.
[0018] Control units 12 are a mouse, a keyboard, etc. and input various kinds of information. The system control section 11 consists of central processing units (CPU) etc., and is outputted to a stand and the berth control section 13 by making into a stand and a berth control signal slice thickness inputted from the control unit 12, rotational speed, berth movement magnitude, etc. The system control section 11 outputs the X-ray beam generating control signal which controls X-ray beam generating to the X-ray control unit 17.
[0019] The system control section 11 outputs the detection control signal which shows the timing of detection of an X-ray beam to the data collection section 27. The system control section 11 outputs the data collection control signal for data collection to the data collection section 27.
[0020] A stand and the berth control section 13 output a berth migration signal to the berth migration section 15 while rotating the rotation stand 25 based on the stand and berth control signal which were outputted by the system control section 11.
[0021] The X-ray control device 17 controls the timing of high-voltage generating by the high-voltage transformer assembly 19 based on the X-ray beam generating control signal outputted by the system control section 11. A high-voltage transformer assembly 19 supplies the high voltage for carrying out exposure of the X-ray beam to the X-ray beam generation source 21 according to the control signal from the X-ray control section 17.
[0022] With the high voltage supplied from the high-voltage transformer assembly 19, the X-ray beam generation source 21 turns to analyte the flabellate form X-ray beam which had thickness in the slice direction, and it carries out exposure from many. Exposure of the detector 23 is carried out from the X-ray beam generation source 21, and it detects the X-ray beam which penetrated analyte.
[0023] Drawing 2 (a) is drawing which expressed the detector 23 in three dimension. A detector 23 consists of a two-dimensional detector by which has the sensing element of many channels and two or

more arrays were carried out in the slice direction. About each train, the sensing element of about 1,000 channels is arranged in the shape of radii considering the focus of the X-ray beam generation source 21 as a core like the detector for single-slice CTs of drawing 2 (b).
[0024] The rotation stand 25 holds the X-ray beam generation source 21 and a detector 23. The rotation stand 25 rotates by the stand rolling mechanism which is not illustrated centering on the revolving shaft which passes along the midpoint of the X-ray beam generation source 21 and a detector 23. In addition, while the X-ray beam generation source 21 and a detector 23 rotate the perimeter of analyte one time, it calls it one scanning actuation to collect the projection data of two or more slices (two or more cross sections) of analyte.
[0025] The data collection section 27 collects and outputs the projection data of two or more slices of analyte to coincidence based on the data collection control signal outputted by the system control section 11. The collection data storage 29 memorizes the projection data of two or more slices of the analyte collected by the data collection section 27.
[0026] The image reconstruction section 31 reconfigurates two or more fault images of analyte to coincidence based on the projection data of two or more slices memorized by the collection data storage 29. A display 33 displays on a monitor two or more fault images of the analyte reconfigurated in the image reconstruction section 31 on coincidence.
[0027] Moreover, the system control section 11 has the ROI specification part 41, the scanning start condition setting section 43, the CT valve judging section 45, and the scanning control section 47. The ROI specification part 41 specifies two or more ROIs in the three-dimension data based on two or more fault images of the analyte obtained in the image reconstruction section 31.
[0028] The scanning start condition setting section 43 sets up the scanning start condition for stopping the real PUREPPU scan which pours the contrast medium from the contrast-medium transfer pipet 44 into Analyte P, and is carried out, and usually starting a scan.
[0029] The CT valve judging section 45 judges whether the scanning start condition to which the CT valve of two or more ROIs specified in the ROI setting section 41 was set in the scanning start condition setting section 43 was filled.
[0030] The scanning control section 47 makes a scan usually start, when the CT valve of two or more ROIs fills a scanning start condition. Moreover, the scanning control section 47 performs X-ray exposure of a low dose with a real PUREPPU scan, and usually performs X-ray exposure of many dosage comparatively with a scan.
[0031] Next, the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 1st operation constituted in this way is explained, referring to the flow chart of drawing 3 R> 3.
[0032] First, by rotating the X-ray beam generation source 21 and the detector 23 for a multi-slice around Analyte P, the scan for ROI assignment is performed and the three-dimension data (volume data) of Analyte P are collected (step S11). This three-dimension data is volume data based on two or more fault images reconfigurated in the image reconstruction section 431.
[0033] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve in the three-dimension data collected at step S11. For example, as shown in drawing 4 , R1, R2, and R3 are specified as three ROIs in the organ 51 of the three-dimension data 50. Each of R1, R2, and R3 is covering two or more cross sections. Three ROIs are specified using a mouse etc. on the screen of a display 33 in fact.
[0034] In addition, about the specification method of ROI, the following two approaches can be illustrated, for example. The 1st approach sets up suitable window width to the CT valve of three-dimension data, and is an approach of specifying ROI using 3D image included in the set-up window width which extracted only the blood vessel section, for example. The 2nd approach is an approach of performing differential processing etc. to the CT valve of three-dimension data, performing edge detection, extracting the profile of only a certain organ, and specifying ROI.
[0035] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S13). As this scanning start condition, conditions as shown in drawing 5 (a) and drawing 5 (b) can be illustrated, for example.
[0036] In the example shown in drawing 5 (a), when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 into a threshold and a CT valve [in / for a

CT valve / in / for the CT valve in R1 / CT1 and R2 / CT2 and R3] is set to CT3, let CT1>X0, CT2>X0, and CT3>X0 be scanning start conditions. That is, it is contingent [on whether all of each of CT1, CT2, and CT3 exceeded the threshold X0].

[0037] In the example shown in drawing 5 (b), when you make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount and X1 is made into a threshold, let 1(CT12+CT22+CT32)/2>X1 be a scanning start condition. That is, it is contingent [on whether the square root of total of the square of each value of CT1 CT2, and CT3 exceeded the threshold X1].

[0038] In addition, you may be scanning start conditions other than a scanning start condition as shown in drawing 5 (a) and drawing 5 (b), and a suitable identifier is added, the scanning start condition is registered beforehand, and you may set up by reading the scanning start condition.

[0039] Next, after starting impregnation inside [of the contrast medium from the contrast-medium transfer pipet 44] analyte P (step S15), the scanning control section 47 sends out a low-dose control signal to the X-ray control unit 17, and makes a real PUREPPU scan carry out (step S17). With this real PUREPPU scan, the tube electric current mA of the X-ray beam generation source 21 is lowered rather than a scan, it can consider as a low dose or the amount of exposures to Analyte P can usually be lessened by using a special X-ray filter.

[0040] In addition, the scanning control section 47 may be synchronized with impregnation of the contrast medium from the contrast-medium transfer pipet 44, and may make a real PUREPPU scan start. In this case, when a contrast medium is poured in from the contrast-medium transfer pipet 44, the impregnation signal which shows impregnation of a contrast medium is sent out to the scanning control section 47, and the scanning control section 47 makes it synchronize with that impregnation signal, and should just make a real PUREPPU scan start. If it does in this way, a real PUREPPU scan can be certainly carried out to suitable timing.

[0041] Moreover, the scanning control section 47 may carry out exposure of the X-ray intermittently for a while by sending out an intermittent signal to the X-ray control unit 17. If it does in this way, the amount of exposures to Analyte P can be lessened.

[0042] Thus, the CT valve judging section 45 supervises whether the CT valve of two or more specified ROIs reached the scanning start condition (step S19). For example, in the example shown in drawing 5 (a), all of each CT valve of R1, R2, and R3 reach a threshold X0 in time of day t1. Moreover, in the example shown in drawing 5 (b), the square root of total of the square of each CT valve of R1, R2, and R3 reaches a threshold X1 in time of day t2.

[0043] Furthermore, when the CT valve of two or more specified ROIs reaches a scanning start condition, the scanning control section 47 carries out the usual scan of Analyte P (step S21). In this case, exposure of comparatively a lot of X-rays is carried out to Analyte P, and inspection data are collected.

[0044] Thus, two or more ROIs are specified using three-dimension data, and since X dosage is raised and a scan is usually started when the CT valve of two or more specified ROIs reaches a scanning start condition, the whole organ can collect inspection data to the timing which dyed best with the contrast medium. For this reason, ****** etc. can be made clearer.

[0045] In addition, drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 6 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 1st operation to drawing 7 is shown.

[0046] As shown in drawing 6 (a), if R1 is specified in organ 51a of one cross section S1 (one slice) and the CT valve of Rspecified 1 reaches a threshold X0 at time of day t3, by the conventional approach, a scan will usually be started. Since only one cross section is observed by this approach, at time of day t3, the CT valve of R2 is not ****(ed) to a threshold X0 so that drawing 7 (b) may also show. For this reason, the whole organ was collecting inspection data to the timing which does not fully dye.

[0047] On the other hand, as shown in drawing 7 (a), by the approach of the gestalt the 1st operation, R1, R2, and R3 are specified in organ 51b covering two or more cross sections, and a scan is usually started at the time of day t4 when all the CT valves of R1, R2, and R3 reached the threshold X0. For this reason, the whole organ can collect inspection data to the timing which dyed best with the contrast medium.

[0048] The X-ray CT scanner of <the gestalt of the 2nd operation>, next the gestalt of operation of the 2nd of this invention is explained. The X-ray CT scanner of the gestalt of the 2nd operation is characterized by collecting inspection data to the optimal imaging timing to each blood vessel group of a different blood vessel group. The three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 2nd operation is explained referring to the flow chart of drawing 8 .
[0049] First, the scan for ROI assignment is performed and the three-dimension data of Analyte P are collected (step S31).
[0050] Next, the ROI specification part 41 specifies two or more ROIs for supervising a CT valve out of collected three-dimension data. For example, as shown in drawing 9 , R4 is specified in the main artery 55 of the three-dimension data 50, and R5 is specified in an organ 53.
[0051] Next, the scanning start condition setting section 43 sets up the scanning start condition which starts inspection data (it usually scans) collection of Analyte P (step S33). As a scanning start condition, conditions as shown in drawing 10 can be illustrated, for example.
[0052] In the example shown in drawing 10 , when make an axis of ordinate into a CT valve, you make an axis of abscissa into time amount, you make X0 and X1 into a threshold and a CT valve [in / for the CT valve in R4 / CT4 and R5] is set to CT5, make CT4>X0 into the 1st scan start condition, and let CT5>X1 be the 2nd scan start condition. In addition, it is good also considering |CT4-CT5|<X2 as the 2nd scan start condition.
[0053] the [next, / for R4 as which the scanning control section 47 was specified after starting impregnation of the contrast medium from the contrast-medium transfer pipet 44 to the interior of analyte P (step S35)] -- 1 real PUREPPU scan is made to carry out (step S37)
[0054] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 4 reached the 1st scan start condition (step S39). As the CT valve of Rspecified 4 shows drawing 10 , when the 1st scan start condition is reached at time of day t5, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 1st inspection data (step S41).
[0055] the [next, / for R5 as which the scanning control section 47 was specified] -- 2 real PUREPPU scan is made to carry out (step S43)
[0056] And the CT valve judging section 45 supervises whether the CT valve of Rspecified 5 reached the 2nd scan start condition (step S45). As the CT valve of Rspecified 5 shows drawing 10 , when the 2nd scan start condition is reached at time of day t6, the scanning control section 47 carries out the usual scan of Analyte P, in order to collect the 2nd inspection data (step S47). In addition, only a count [need / step S43 to the step S47 / to be processed] is performed repeatedly.
[0057] Thus, since it judges whether the scanning start condition to which ROI was specified as each of two blood vessels, the scanning start condition was set up according to the individual for every ROI, and the CT valve of ROI was set to the ROI was reached, inspection data are collectable to two optimal different imaging timing.
[0058] In addition, you may carry out also in this case by synchronizing scanning initiation timing with the impregnation timing of the contrast medium from the contrast-medium transfer pipet 44, and exposure of the X-ray may be carried out intermittently.
[0059] Drawing which explains imaging timing with the conventional real PUREPPU scan to drawing 11 is shown. Drawing which explains imaging timing with the real PUREPPU scan of the gestalt of the 2nd operation to drawing 12 is shown.
[0060] As shown in drawing 11 (a), if R4 (main artery) is specified in one cross section S2 (one slice) and the CT valve of Rspecified 4 reaches a threshold X0 at time of day t7, by the conventional approach, a scan (the 1st scan) will usually be started. By this approach, it is the optimal imaging timing for an artery layer. However, since only R4 is observed, the optimal imaging timing of a balanced layer or a portal vein layer is not known. For this reason, the imaging timing of a balanced layer or a portal vein layer was dependent on a way person's can, and experience. In addition, in drawing 11 (b), the time amount td from the end time of an artery layer to the start time of a balanced layer is the time amount depending on a way person's can, and experience.
[0061] On the other hand, as shown in drawing 12 (a), by the approach of the gestalt the 2nd operation, R4 (main artery) is specified in a blood vessel 55, R5 (portal vein) is specified in a blood vessel 53, when the CT valve of R4 reaches the 1st scan start condition at time of day t7, the 1st scan is started,

and when the CT valve of R5 reaches the 2nd scan start condition at time of day t9, the 2nd scan is started. Therefore, inspection data are collectable to the imaging timing optimal about each of an artery layer, a portal vein layer, and a balanced layer.

[0062] The X-ray CT scanner of <the gestalt of the 3rd operation>, next the gestalt of operation of the 3rd of this invention is explained. Drawing 13 is the configuration block Fig. of the principal part of the X-ray CT scanner of the gestalt of the 3rd operation. This X-ray CT scanner is further characterized by having a slit 61 and the slit control section 63, as shown in drawing 13 .

[0063] A slit 61 is formed between the X-ray beam generation source 21 and Analyte P, and has the movable X-ray shield of two sheets along the slice direction. The slit control section 63 controls width of face between X-ray shields of two sheets of a slit 61 based on two or more ROIs specified with the ROI specification part 41 in system control section 11a to carry out exposure of the X-ray only to two or more slices corresponding to two or more of these ROIs.

[0064] As shown in drawing 13 , according to the constituted X-ray CT scanner, thus, the slit control section 63 In order [corresponding to R1 and R2 which were specified] to control width of face between X-ray shields of two sheets of a slit 61 to carry out exposure of X-ray FB only, for example to three slices, Since exposure of the X-ray is not carried out to the remaining parts of organs 57 other than R1 and R2, the unnecessary amount of exposures to Analyte P can be lessened.

[0065] In addition, this invention is not limited to the X-ray CT scanner of the gestalt of the 1st mentioned above thru/or the 3rd operation. With the gestalt of the 1st thru/or the 3rd operation, although the detector 23 for a multi-slice was used, as shown in drawing 14 , three-dimension data may be collected using the flat-surface detector 65 by rotating the X-ray beam generation source 21 and the flat-surface detector 65 around Analyte P, for example.

[0066] Moreover, using detector 23a for a single slice as shown in drawing 2 (b), by moving berth 15a in the slice direction at a predetermined rate by the berth migration section 15, helical scan may be performed and the helical data obtained by helical scan, i.e., the three-dimension data of analyte, may be collected.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the system configuration Fig. showing the outline configuration of the 1st of the X-ray CT scanner of the gestalt of operation of this invention.

[Drawing 2] It is drawing which expressed the detector in three dimension.

[Drawing 3] It is the flow chart which shows the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 1st operation.

[Drawing 4] It is drawing showing three ROIs specified in the organ.

[Drawing 5] It is drawing showing the scanning start condition of the gestalt of the 1st operation.

[Drawing 6] It is drawing explaining imaging timing with the conventional real PUREPPU scan.

[Drawing 7] It is drawing explaining imaging timing with the real PUREPPU scan of the gestalt of the 1st operation.

[Drawing 8] It is the flow chart which shows the three-dimension real PUREPPU processing by the X-ray CT scanner of the gestalt of the 2nd operation.

[Drawing 9] It is drawing showing ROI specified as each of a main artery and a portal vein.

[Drawing 10] It is drawing showing the scanning start condition of the gestalt of the 2nd operation.

[Drawing 11] It is drawing explaining imaging timing with the conventional real PUREPPU scan.

[Drawing 12] It is drawing explaining imaging timing with the real PUREPPU scan of the gestalt of the 2nd operation.

[Drawing 13] It is the configuration block Fig. of the principal part of the X-ray CT scanner of the gestalt of the 3rd operation.

[Drawing 14] It is drawing showing the X-ray CT scanner which collects three-dimension data using a flat-surface detector.

[Description of Notations]

10 [-- A stand and a berth control section,] -- An X-ray CT scanner, 11 -- The system control section, 12 -- A control unit, 13 15 [-- High-voltage transformer assembly,] -- The berth migration section, 15a -- A berth, 17 -- An X-ray control unit, 19 21 [-- Data collection section,] -- An X-ray beam generation source, 23 -- A detector, 25 -- A rotation stand, 27 29 [-- ROI specification part,] -- Collection data storage, 31 -- The image reconstruction section, 33 -- A display, 41 43 [-- A scanning control section, 61 / -- A slit, 63 / -- A slit control section, 65 / -- A flat-surface detector, P / -- Analyte, R1-R5 / -- ROI (area of interest).] -- The scanning start condition setting section, 44 -- Contrast-medium transfer pipet, 45 -- The CT valve judging section, 47

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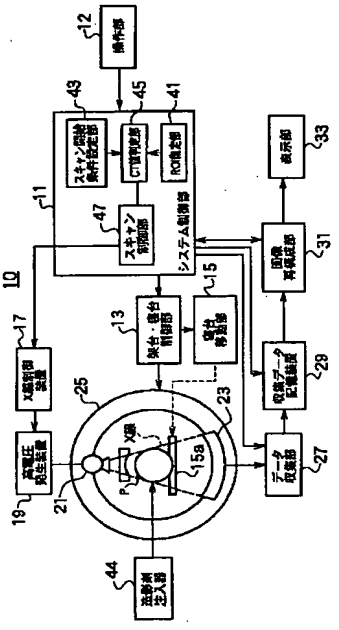
最終頁に続く

(54)【発明の名称】　Ｘ線ＣＴ装置

(57)【要約】
【課題】　臓器全体の造影状態の監視や異なる血管群の造影状態の監視を行うことにより最適な造影タイミングで被検体の検査データを収集する。
【解決手段】　ＲＯＩ指定部４１は、被検体Ｐの３次元データに基づく３次元領域内で被検体Ｐの複数の関心領域を指定し、スキャン開始条件設定部４３は、検査スキャンを開始するためのスキャン開始条件を設定し、ＣＴ値判定部４５は、被検体Ｐに造影剤を注入した後にＲＯＩ指定部４１により指定された複数の関心領域のＣＴ値がスキャン開始条件設定部４３で設定されたスキャン開始条件に達したかどうかを判定し、スキャン制御部４７は、複数の関心領域のＣＴ値がスキャン開始条件に達した場合に被検体Ｐの検査スキャンを開始させる。



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【特許請求の範囲】

【請求項１】　被検体の３次元データに基づく３次元領域内で被検体の複数の関心領域を指定する指定手段と、前記被検体に造影剤を注入した後に前記指定手段により指定された前記複数の関心領域のＣＴ値の変化を監視する監視手段と、

この監視手段により監視された前記複数の関心領域のＣＴ値の変化に基づき前記被検体の検査スキャンを開始させるスキャン制御手段と、を備えることを特徴とするＸ線ＣＴ装置。

【請求項２】　前記監視手段は、前記指定手段により指定された前記複数の関心領域のＣＴ値が前記検査スキャンを開始するための予め設定されたスキャン開始条件に達したかどうかを判定し、

前記スキャン制御手段は、前記複数の関心領域のＣＴ値が前記スキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする請求項１記載のＸ線ＣＴ装置。

【請求項３】　前記３次元データは、ヘリカルスキャンにより得られたヘリカルデータまたは前記被検体のスライス方向に複数列配列された２次元検出器を用いて得られたデータまたは平面検出器を用いて得られたデータであることを特徴とする請求項１記載のＸ線ＣＴ装置。

【請求項４】　前記指定手段は、前記３次元データのＣＴ値を予め定められたしきい値と比較することにより特定部位を抽出し、抽出された特定部位に前記複数の関心領域を指定することを特徴とする請求項１記載のＸ線ＣＴ装置。

【請求項５】　前記監視手段は、前記スキャン開始条件として、前記複数の関心領域の全てのＣＴ値が予め定められたしきい値を越えたかどうかを判定することを特徴とする請求項２記載のＸ線ＣＴ装置。

【請求項６】　前記監視手段は、各関心領域毎に前記スキャン開始条件が個別に設定されている場合に、各関心領域毎にその関心領域のＣＴ値がその関心領域に個別に設定されたスキャン開始条件に達したかどうかを判定し、

前記スキャン制御手段は、各関心領域毎にその関心領域のＣＴ値がその関心領域に個別に設定されたスキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする請求項２記載のＸ線ＣＴ装置。

【請求項７】　Ｘ線源と前記被検体との間に設けられ、前記被検体のスライス方向に沿って移動可能な２枚のＸ線遮蔽板を有するスリットと、

前記監視手段がＣＴ値の変化を監視している間、前記複数の関心領域に対応した複数スライスのみに前記Ｘ線源からのＸ線を曝射するように前記スリットの２枚のＸ線遮蔽板相互間の幅を制御するスリット制御手段と、を備えることを特徴とする請求項１記載のＸ線ＣＴ装置。

【発明の詳細な説明】

2

【０００１】

【発明の属する技術分野】本発明は、全身用Ｘ線ＣＴ装置に関し、特に、造影剤を被検体内部に注入し、最適な造影タイミングで被検体をスキャンするＸ線ＣＴ装置に関する。

【０００２】

【従来の技術】従来、Ｘ線ＣＴ装置において、癌変部を明瞭にするために造影剤を被検体内部に注入し、最適な造影タイミングで被検体をスキャンするリアルプレップスキャンが知られている。

【０００３】このリアルプレップスキャンにおいては、まず、被検体の一断面像を使用し、この一断面内部の例えば大動脈等の関心領域（以下、ＲＯＩと略称する。）を指定し、そのＲＯＩのＣＴ値を監視する。

【０００４】そして、被検体内部に注入された造影剤によりそのＲＯＩのＣＴ値が上昇して、そのＣＴ値がある閾値に達したとき、そのＲＯＩが造影剤により十分染まったことを確認する。その後、被検体の検査データの収集を開始する。従って、最適な造影タイミングでスキャンすることができるため、被検体に依らない確実な造影タイミングの捕捉に極めて有効である。

【０００５】

【発明が解決しようとする課題】しかしながら、従来のリアルプレップスキャンにあっては、被検体の一断面のみにおけるＲＯＩのＣＴ値を監視していたため、観察したい臓器の領域全体が造影剤により最も良く染まったかどうかを観察することができなかった。

【０００６】また、例えば、動脈層と門脈層を観察したい場合に、ちょうど同じ断面像に最適な動脈血管、門脈血管がないときには、動脈血管と門脈血管との両者を同時に監視することは困難であった。

【０００７】本発明の目的は、臓器全体の造影状態の監視や異なる血管群の造影状態の監視を行うことにより、最適な造影タイミングで被検体の検査データを収集することができるＸ線ＣＴ装置を提供することにある。

【０００８】

【課題を解決するための手段】本発明は前記課題を解決するために以下の構成とした。本発明は、被検体の３次元データに基づく３次元領域内で被検体の複数の関心領域を指定する指定手段と、前記被検体に造影剤を注入した後に前記指定手段により指定された前記複数の関心領域のＣＴ値の変化を監視する監視手段と、この監視手段により監視された前記複数の関心領域のＣＴ値の変化に基づき前記被検体の検査スキャンを開始させるスキャン制御手段とを備えることを特徴とする。

【０００９】この発明によれば、指定手段が被検体の３次元データに基づく３次元領域内で被検体の複数の関心領域を指定すると、監視手段は、被検体に造影剤を注入した後に指定手段により指定された複数の関心領域のＣＴ値の変化を監視し、スキャン制御手段は、監視手段に

より監視された複数の関心領域のＣＴ値の変化に基づき被検体の検査スキャンを開始させる。すなわち、３次元データで複数の関心領域を指定し、臓器全体の造影状態の監視や異なる血管群の造影状態の監視を行うため、臓器全体や異なる血管群に対して最適な造影タイミングで被検体の検査データを収集することができる。

【００１０】また、前記監視手段は、前記指定手段により指定された前記複数の関心領域のＣＴ値が前記検査スキャンを開始するための予め設定されたスキャン開始条件に達したかどうかを判定し、前記スキャン制御手段は、前記複数の関心領域のＣＴ値が前記スキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする。

【００１１】この発明によれば、監視手段は、指定手段により指定された複数の関心領域のＣＴ値が検査スキャンを開始するための予め設定されたスキャン開始条件に達したかどうかを判定し、スキャン制御手段は、複数の関心領域のＣＴ値がスキャン開始条件に達した場合に被検体の検査スキャンを開始させるため、臓器全体や異なる血管群に対して最適な造影タイミングで被検体の検査データを収集することができる。

【００１２】また、前記監視手段は、各関心領域毎に前記スキャン開始条件が個別に設定されている場合に、各関心領域毎にその関心領域のＣＴ値がその関心領域に個別に設定されたスキャン開始条件に達したかどうかを判定し、前記スキャン制御手段は、各関心領域毎にその関心領域のＣＴ値がその関心領域に個別に設定されたスキャン開始条件に達した場合に前記被検体の検査スキャンを開始させることを特徴とする。

【００１３】この発明によれば、監視手段は、各関心領域毎にスキャン開始条件が個別に設定されている場合に、各関心領域毎にその関心領域のＣＴ値がその関心領域に個別に設定されたスキャン開始条件に達したかどうかを判定し、スキャン制御手段は、各関心領域毎にその関心領域のＣＴ値がその関心領域に個別に設定されたスキャン開始条件に達した場合に被検体の検査スキャンを開始させるため、各関心領域毎に最適な造影タイミングで被検体の検査データを収集することができる。

【００１４】また、Ｘ線源と前記被検体との間に設けられ、前記被検体のスライス方向に沿って移動可能な２枚のＸ線遮蔽板を有するスリットと、前記監視手段がＣＴ値の変化を監視している間、前記複数の関心領域に対応した複数スライスのみに前記Ｘ線源からのＸ線を曝射するように前記スリットの２枚のＸ線遮蔽板相互間の幅を制御するスリット制御手段とを備えることを特徴とする。

【００１５】この発明によれば、監視手段がＣＴ値の変化を監視している間、スリット制御手段は、複数の関心領域に対応した複数スライスのみにＸ線源からのＸ線を曝射するようにスリットの２枚のＸ線遮蔽板相互間の幅を制御するため、被検体へのＸ線の被曝量を少なくすることができる。

【００１６】

【発明の実施の形態】以下、本発明のＸ線ＣＴ装置の実施の形態を図面を参照して詳細に説明する。

【００１７】＜第１の実施の形態＞図１は、本発明の第１の実施の形態のＸ線ＣＴ装置の概略構成を示すシステム構成図である。図１において、第１の実施の形態のＸ線ＣＴ装置１０は、システム制御部１１、操作部１２、架台・寝台制御部１３、寝台移動部１５、Ｘ線制御装置１７、高電圧発生装置１９、Ｘ線ビーム発生源２１、検出器２３、回転架台２５、データ収集部２７、収集データ記憶装置２９、画像再構成部３１、表示部３３を有している。このＸ線ＣＴ装置１０は、Ｘ線ビーム発生源２１を被検体Ｐの回りに回転させながらＸ線ビームを曝射させるものである。

【００１８】操作部１２は、マウス、キーボード等であり、各種の情報を入力する。システム制御部１１は、中央処理装置（ＣＰＵ）等から構成され、操作部１２から入力されたスライス厚、回転速度、寝台移動量等を架台・寝台制御信号として架台・寝台制御部１３に対して出力する。システム制御部１１は、Ｘ線ビーム発生を制御するＸ線ビーム発生制御信号をＸ線制御装置１７に対して出力する。

【００１９】システム制御部１１は、Ｘ線ビームの検出のタイミングを示す検出制御信号をデータ収集部２７に対して出力する。システム制御部１１は、データ収集のためのデータ収集制御信号をデータ収集部２７に対して出力する。

【００２０】架台・寝台制御部１３は、システム制御部１１により出力された架台、寝台制御信号に基づき回転架台２５を回転させると共に、寝台移動信号を寝台移動部１５に対して出力する。

【００２１】Ｘ線制御装置１７は、システム制御部１１により出力されたＸ線ビーム発生制御信号に基づき、高電圧発生装置１９による高電圧発生のタイミングを制御する。高電圧発生装置１９は、Ｘ線ビームを曝射させるための高電圧をＸ線制御部１７からの制御信号に従ってＸ線ビーム発生源２１に供給する。

【００２２】Ｘ線ビーム発生源２１は、高電圧発生装置１９から供給された高電圧によってスライス方向に厚みを持った扇状のＸ線ビームを被検体に向けて多方向から曝射する。検出器２３は、Ｘ線ビーム発生源２１から曝射され、被検体を透過したＸ線ビームを検出する。

【００２３】図２（ａ）は、検出器２３を３次元的に表した図である。検出器２３は、多チャンネルの検出素子を有し且つスライス方向に複数配列された２次元検出器からなる。各列については、図２（ｂ）のシングルスライスＣＴ用検出器と同様に１，０００チャンネル程度の検出素子がＸ線ビーム発生源２１の焦点を中心として円

弧状に配置される。

【００２４】回転架台２５は、Ｘ線ビーム発生源２１と検出器２３とを保持する。回転架台２５は、図示しない架台回転機構により、Ｘ線ビーム発生源２１と検出器２３との中間点を通る回転軸を中心にして回転される。なお、Ｘ線ビーム発生源２１と検出器２３とが被検体の周囲を１回転しながら、被検体の複数スライス（複数断面）の投影データを収集することを１回のスキャン動作と称する。

【００２５】データ収集部２７は、システム制御部１１により出力されたデータ収集制御信号に基づき被検体の複数スライスの投影データを同時に収集して出力する。収集データ記憶装置２９は、データ収集部２７によって収集された被検体の複数スライスの投影データを記憶する。

【００２６】画像再構成部３１は、収集データ記憶装置２９に記憶された複数スライスの投影データに基づき被検体の複数の断層画像を同時に再構成する。表示部３３は、画像再構成部３１で再構成された被検体の複数の断層画像を同時にモニタ上に表示する。

【００２７】また、システム制御部１１は、ＲＯＩ指定部４１、スキャン開始条件設定部４３、ＣＴ値判定部４５、スキャン制御部４７を有している。ＲＯＩ指定部４１は、画像再構成部３１で得られた被検体の複数の断層画像に基づく３次元データの中に複数のＲＯＩを指定する。

【００２８】スキャン開始条件設定部４３は、造影剤注入器４４からの造影剤を被検体Ｐに注入して実施されるリアルプレップスキャンを停止させて通常スキャンを開始するためのスキャン開始条件を設定する。

【００２９】ＣＴ値判定部４５は、ＲＯＩ設定部４１で指定された複数のＲＯＩのＣＴ値がスキャン開始条件設定部４３で設定されたスキャン開始条件を満たしたかどうかを判定する。

【００３０】スキャン制御部４７は、複数のＲＯＩのＣＴ値がスキャン開始条件を満たした場合には、通常スキャンを開始させる。また、スキャン制御部４７は、リアルプレップスキャンでは低線量のＸ線曝射を行い、通常スキャンでは比較的多線量のＸ線曝射を行う。

【００３１】次にこのように構成された第１の実施の形態のＸ線ＣＴ装置による３次元リアルプレップ処理を図３のフローチャートを参照しながら説明する。

【００３２】まず、Ｘ線ビーム発生源２１とマルチスライス用の検出器２３とを被検体Ｐの回りに回転させることにより、ＲＯＩ指定用スキャンを行い、被検体Ｐの３次元データ（ボリュームデータ）を収集する（ステップＳ１１）。この３次元データは、画像再構成部４３１で再構成された複数の断層画像に基づくボリュームデータである。

【００３３】次に、ＲＯＩ指定部４１は、ステップＳ１１で収集した３次元データの中にＣＴ値を監視するための複数のＲＯＩを指定する。例えば、図４に示すように、３次元データ５０の臓器５１の中に３つのＲＯＩとしてＲ１，Ｒ２，Ｒ３を指定する。Ｒ１，Ｒ２，Ｒ３のそれぞれは、複数の断面に亘っている。３つのＲＯＩは、実際には表示部３３の画面上でマウス等を用いて指定される。

【００３４】なお、ＲＯＩの指定方法については、例えば、以下の２つの方法を例示することができる。第１の方法は、３次元データのＣＴ値に対して適当なウインドウ幅を設定し、設定されたウインドウ幅に入る例えば、血管部のみを抽出した３Ｄ像を用いてＲＯＩを指定する方法である。第２の方法は、３次元データのＣＴ値に対して微分処理等を施してエッジ検出を行い、ある臓器のみの輪郭を抽出してＲＯＩを指定する方法である。

【００３５】次に、スキャン開始条件設定部４３は、被検体Ｐの検査データ（通常スキャン）収集を開始するスキャン開始条件を設定する（ステップＳ１３）。このスキャン開始条件としては、例えば、図５（ａ）や図５（ｂ）に示すような条件を例示することができる。

【００３６】図５（ａ）に示す例では、縦軸をＣＴ値とし、横軸を時間とし、X_0をしきい値とし、Ｒ１におけるＣＴ値をＣＴ１、Ｒ２におけるＣＴ値をＣＴ２、Ｒ３におけるＣＴ値をＣＴ３とした場合に、ＣＴ１＞X_0，ＣＴ２＞X_0，ＣＴ３＞X_0をスキャン開始条件とする。すなわち、ＣＴ１，ＣＴ２，ＣＴ３のそれぞれが全てしきい値X_0を越えたかどうかを条件とする。

【００３７】図５（ｂ）に示す例では、縦軸をＣＴ値とし、横軸を時間とし、X_1をしきい値とした場合に、$(CT1^2+CT2^2+CT3^2)^{1/2}>X_1$をスキャン開始条件とする。すなわち、ＣＴ１，ＣＴ２，ＣＴ３のそれぞれの値の二乗の総和の平方根がしきい値X_1を越えたかどうかを条件とする。

【００３８】なお、図５（ａ）、図５（ｂ）に示すようなスキャン開始条件以外のスキャン開始条件であっても良く、また適当な名前を付加してスキャン開始条件を予め登録しておき、そのスキャン開始条件を読み出すことで設定しても良い。

【００３９】次に、造影剤注入器４４からの造影剤の被検体Ｐ内部への注入を開始した後（ステップＳ１５）、スキャン制御部４７は、Ｘ線制御装置１７に対して低線量制御信号を送出し、リアルプレップスキャンを実施させる（ステップＳ１７）。このリアルプレップスキャンでは、通常スキャンよりもＸ線ビーム発生源２１の管電流ｍＡを下げて低線量としたり、特殊なＸ線フィルターを用いることで、被検体Ｐへの被曝量を少なくすることができる。

【００４０】なお、スキャン制御部４７は、造影剤注入器４４からの造影剤の注入に同期させて、リアルプレップスキャンを開始させてもよい。この場合、造影剤注入

器４４から造影剤を注入したとき、造影剤の注入を示す注入信号をスキャン制御部４７に送出し、スキャン制御部４７がその注入信号に同期させてリアルブレップスキャンを開始させればよい。このようにすれば、適切なタイミングで確実にリアルブレップスキャンを実施することができる。

【００４１】また、スキャン制御部４７は、Ｘ線制御装置１７に対して間欠信号を送出することにより、しばらくの間、Ｘ線を間欠的に曝射させても良い。このようにすれば、被検体Ｐへの被曝量を少なくすることができる。

【００４２】このようにして、ＣＴ値判定部4-5は、指定された複数のＲＯＩのＣＴ値がスキャン開始条件に達したかどうかを監視する（ステップＳ１９）。例えば、図５（ａ）に示す例では、時刻t_1において、Ｒ１，Ｒ２，Ｒ３のそれぞれのＣＴ値が全てしきい値X_0に達する。また、図５（ｂ）に示す例では、時刻t_2において、Ｒ１，Ｒ２，Ｒ３のそれぞれのＣＴ値の二乗の総和の平方根がしきい値X_1に達する。

【００４３】さらに、指定された複数のＲＯＩのＣＴ値がスキャン開始条件に達した場合には、スキャン制御部４７は、被検体Ｐの通常スキャンを実施する（ステップＳ２１）。この場合には、比較的多量のＸ線を被検体Ｐに曝射して検査データを収集する。

【００４４】このように、３次元データを用いて複数のＲＯＩを指定し、指定された複数のＲＯＩのＣＴ値がスキャン開始条件に達したときに、Ｘ線量を上げて通常スキャンを開始するので、臓器全体が造影剤により最も良く染まったタイミングで検査データを収集することができる。このため、癌変部等をより明瞭にすることができる。

【００４５】なお、図６に従来のリアルブレップスキャンによる造影タイミングを説明する図を示す。図７に第１の実施の形態のリアルブレップスキャンによる造影タイミングを説明する図を示す。

【００４６】図６（ａ）に示すように、従来の方法では、一断面Ｓ１（１スライス）の臓器５１ａの中にＲ１を指定し、指定されたＲ１のＣＴ値が時刻t_3でしきい値X_0に達すると、通常スキャンを開始する。この方法では、一断面しか観察していないため、図７（ｂ）からもわかるように、時刻t_3では、Ｒ２のＣＴ値はしきい値X_0に達っしていない。このため、臓器全体が十分に染まらないタイミングで検査データを収集していた。

【００４７】一方、図７（ａ）に示すように、第１の実施の形態の方法では、複数の断面に亘る臓器５１ｂの中にＲ１，Ｒ２，Ｒ３を指定し、Ｒ１，Ｒ２，Ｒ３のＣＴ値の全てがしきい値X_0に達した時刻t_4で、通常スキャンを開始する。このため、臓器全体が造影剤により最も良く染まったタイミングで検査データを収集することができる。

【００４８】＜第２の実施の形態＞次に、本発明の第２の実施の形態のＸ線ＣＴ装置を説明する。第２の実施の形態のＸ線ＣＴ装置は、異なる血管群のそれぞれの血管群に対して、最適な造影タイミングで検査データを収集することを特徴とする。第２の実施の形態のＸ線ＣＴ装置による３次元リアルブレップ処理を図８のフローチャートを参照しながら説明する。

【００４９】まず、ＲＯＩ指定用スキャンを行い、被検体Ｐの３次元データを収集する（ステップＳ３１）。

【００５０】次に、ＲＯＩ指定部４１は、収集した３次元データの中から、ＣＴ値を監視するための複数のＲＯＩを指定する。例えば、図９に示すように、３次元データ５０の大動脈５５の中にＲ４を指定し、臓器５３の中にＲ５を指定する。

【００５１】次に、スキャン開始条件設定部４３は、被検体Ｐの検査データ（通常スキャン）収集を開始するスキャン開始条件を設定する（ステップＳ３３）。スキャン開始条件としては、例えば、図１０に示すような条件を例示することができる。

【００５２】図１０に示す例では、縦軸をＣＴ値とし、横軸を時間とし、X_0，X_1をしきい値とし、Ｒ４におけるＣＴ値をＣＴ４、Ｒ５におけるＣＴ値をＣＴ５とした場合に、ＣＴ４＞X_0を第１スキャン開始条件とし、ＣＴ５＞X_1を第２スキャン開始条件とする。なお、｜ＣＴ４－ＣＴ５｜＜X_2を第２スキャン開始条件としても良い。

【００５３】次に、造影剤注入器４４から被検体Ｐ内部への造影剤の注入を開始した後（ステップＳ３５）、スキャン制御部４７は、指定されたＲ４のための第１リアルブレップスキャンを実施させる（ステップＳ３７）。

【００５４】そして、ＣＴ値判定部４５は、指定されたＲ４のＣＴ値が第１スキャン開始条件に達したかどうかを監視する（ステップＳ３９）。指定されたＲ４のＣＴ値が図１０に示すように時刻t_5で第１スキャン開始条件に達した場合には、スキャン制御部４７は、第１検査データを収集するために被検体Ｐの通常スキャンを実施する（ステップＳ４１）。

【００５５】次に、スキャン制御部４７は、指定されたＲ５のための第２リアルブレップスキャンを実施させる（ステップＳ４３）。

【００５６】そして、ＣＴ値判定部４５は、指定されたＲ５のＣＴ値が第２スキャン開始条件に達したかどうかを監視する（ステップＳ４５）。指定されたＲ５のＣＴ値が図１０に示すように時刻t_6で第２スキャン開始条件に達した場合には、スキャン制御部４７は、第２検査データを収集するために被検体Ｐの通常スキャンを実施する（ステップＳ４７）。なお、ステップＳ４３からステップＳ４７の処理は必要な回数だけ繰り返し行われる。

【００５７】このように、２つの血管のそれぞれにＲＯ

Ｉを指定し、各ＲＯＩ毎にスキャン開始条件を個別に設定し、ＲＯＩのＣＴ値がそのＲＯＩに対して設定されたスキャン開始条件に達したかどうかを判定するため、異なる２つの最適な造影タイミングで、検査データを収集することができる。

【００５８】なお、この場合においても、スキャン開始タイミングを造影剤注入器４４からの造影剤の注入タイミングと同期させて行っても良く、また、間欠的にＸ線を曝射しても良い。

【００５９】図１１に従来のリアルブレッブスキャンによる造影タイミングを説明する図を示す。図１２に第２の実施の形態のリアルブレッブスキャンによる造影タイミングを説明する図を示す。

【００６０】図１１（ａ）に示すように、従来の方法では、一断面Ｓ２（１スライス）の中にＲ４（大動脈）を指定し、指定されたＲ４のＣＴ値が時刻t_1でしきい値X_0に達すると、通常スキャン（第１スキャン）を開始する。この方法では、動脈層には最適な造影タイミングである。しかし、Ｒ４しか観察していないため、平衡層や門脈層の最適な造影タイミングがわからない。このため、平衡層や門脈層の造影タイミングは、術者のカンと経験に依存していた。なお、図１１（ｂ）において、動脈層の終了時刻から平衡層の開始時刻までの時間ｔｄが、術者のカンと経験に依存する時間である。

【００６１】一方、図１２（ａ）に示すように、第２の実施の形態の方法では、血管５５の中にＲ４（大動脈）を指定し、血管５３の中にＲ５（門脈）を指定し、Ｒ４のＣＴ値が時刻t_1で第１スキャン開始条件に達した場合に第１スキャンを開始し、Ｒ５のＣＴ値が時刻t_2で第２スキャン開始条件に達した場合に第２スキャンを開始する。従って、動脈層、門脈層、平衡層のそれぞれについて最適な造影タイミングで検査データを収集することができる。

【００６２】＜第３の実施の形態＞次に、本発明の第３の実施の形態のＸ線ＣＴ装置を説明する。図１３は、第３の実施の形態のＸ線ＣＴ装置の主要部の構成ブロック図である。このＸ線ＣＴ装置は、図１３に示すように、さらに、スリット６１、スリット制御部６３を備えることを特徴とする。

【００６３】スリット６１は、Ｘ線ビーム発生源２１と被検体Ｐとの間に設けられ、スライス方向に沿って移動可能な２枚のＸ線遮蔽板を有する。スリット制御部６３は、システム制御部１１ａ内のＲＯＩ指定部４１で指定された複数のＲＯＩに基づき、この複数のＲＯＩに対応した複数スライスのみにＸ線を曝射するようにスリット６１の２枚のＸ線遮蔽板相互間の幅を制御する。

【００６４】このように構成されたＸ線ＣＴ装置によれば、図１３に示すように、スリット制御部６３は、指定されたＲ１とＲ２とに対応する例えば３つのスライスのみにＸ線ＦＢを曝射するようにスリット６１の２枚のＸ線遮蔽板相互間の幅を制御するため、Ｒ１，Ｒ２以外の臓器５７の残りの部位にＸ線が曝射されないから、被検体Ｐへの不要な被曝量を少なくすることができる。

【００６５】なお、本発明は前述した第１乃至第３の実施の形態のＸ線ＣＴ装置に限定されるものではない。第１乃至第３の実施の形態では、マルチスライス用の検出器２３を用いたが、例えば、図１４に示すように平面検出器６５を用いて、Ｘ線ビーム発生源２１と平面検出器６５とを被検体Ｐの回りに回転させることにより、３次元データを収集してもよい。

【００６６】また、図２（ｂ）に示すようなシングルスライス用の検出器２３ａを用いて、寝台１５ａを寝台移動部１５によりスライス方向に所定速度で移動させることによりヘリカルスキャンを行い、ヘリカルスキャンにより得られたヘリカルデータ、すなわち、被検体の３次元データを収集してもよい。

【００６７】

【発明の効果】本発明によれば、３次元データで複数の関心領域を指定し、臓器全体の造影状態の監視や異なる血管群の造影状態の監視を行うため、臓器全体や異なる血管群に対して最適な造影タイミングで被検体の検査データを収集することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態のＸ線ＣＴ装置の概略構成を示すシステム構成図である。

【図２】検出器を３次元的に表した図である。

【図３】第１の実施の形態のＸ線ＣＴ装置による３次元リアルブレッブ処理を示すフローチャートである。

【図４】臓器の中で指定された３つのＲＯＩを示す図である。

【図５】第１の実施の形態のスキャン開始条件を示す図である。

【図６】従来のリアルブレッブスキャンによる造影タイミングを説明する図である。

【図７】第１の実施の形態のリアルブレッブスキャンによる造影タイミングを説明する図である。

【図８】第２の実施の形態のＸ線ＣＴ装置による３次元リアルブレッブ処理を示すフローチャートである。

【図９】大動脈と門脈とのそれぞれに指定されたＲＯＩを示す図である。

【図１０】第２の実施の形態のスキャン開始条件を示す図である。

【図１１】従来のリアルブレッブスキャンによる造影タイミングを説明する図である。

【図１２】第２の実施の形態のリアルブレッブスキャンによる造影タイミングを説明する図である。

【図１３】第３の実施の形態のＸ線ＣＴ装置の主要部の構成ブロック図である。

【図１４】平面検出器を用いて３次元データを収集するＸ線ＣＴ装置を示す図である。

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【符号の説明】

１０…Ｘ線ＣＴ装置、１１…システム制御部、１２…操作部、１３…架台・寝台制御部、１５…寝台移動部、１５ａ…寝台、１７…Ｘ線制御装置、１９…高電圧発生装置、２１…Ｘ線ビーム発生源、２３…検出器、２５…回転架台、２７…データ収集部、２９…収集データ記憶装＊置、３１…画像再構成部、３３…表示部、４１…ＲＯＩ指定部、４３…スキャン開始条件設定部、４４…造影剤注入器、４５…ＣＴ値判定部、４７…スキャン制御部、６１…スリット、６３…スリット制御部、６５…平面検出器、Ｐ…被検体、Ｒ１～Ｒ５…ＲＯＩ（関心領域）。

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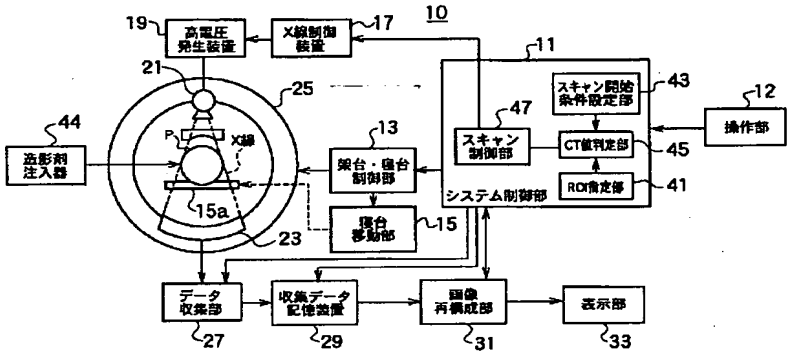
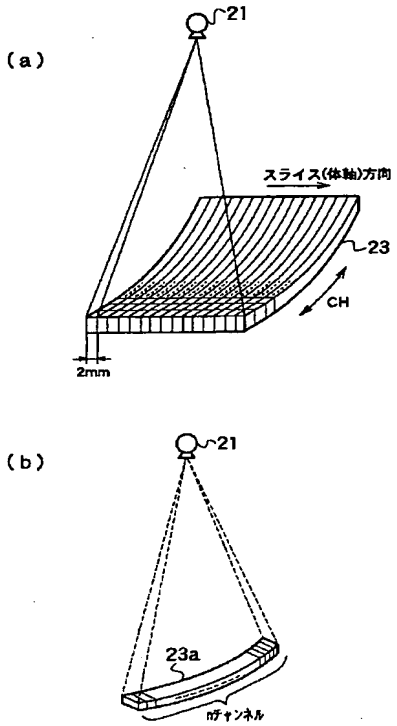
【図１】



【図２】



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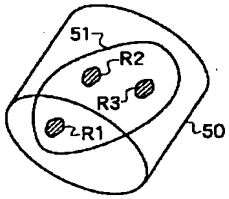
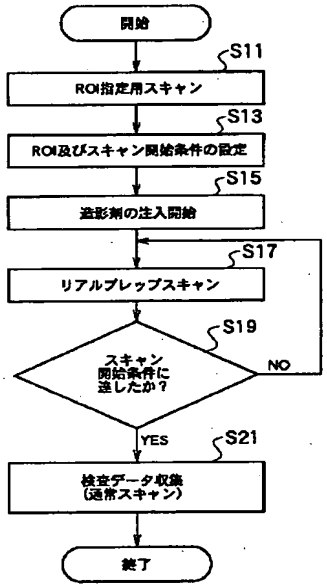


【図３】



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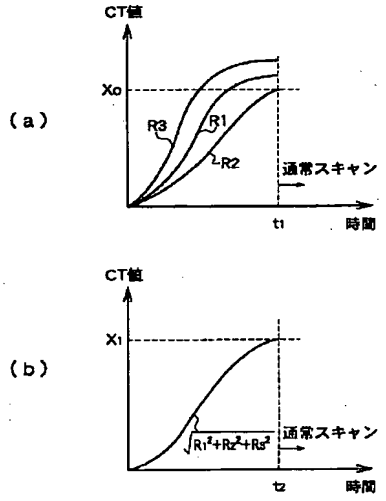
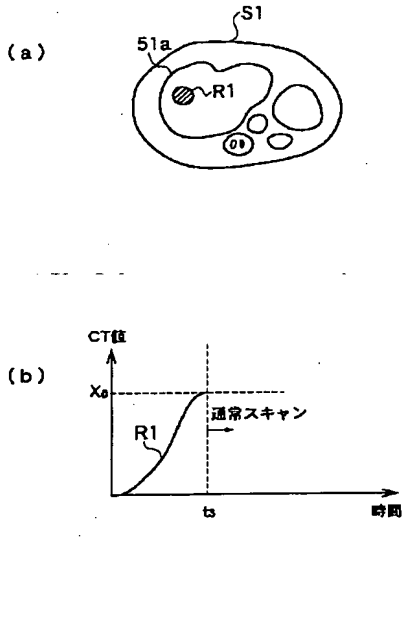


【図６】



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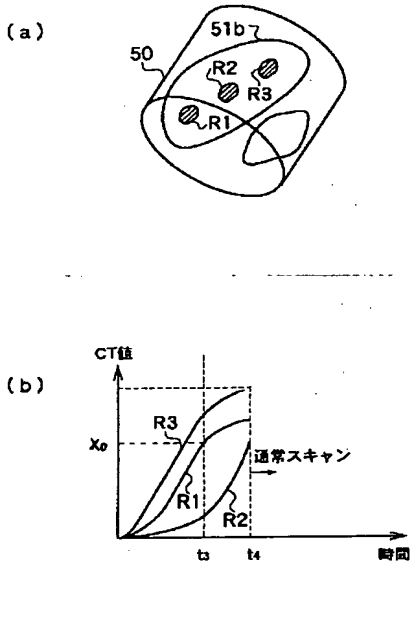

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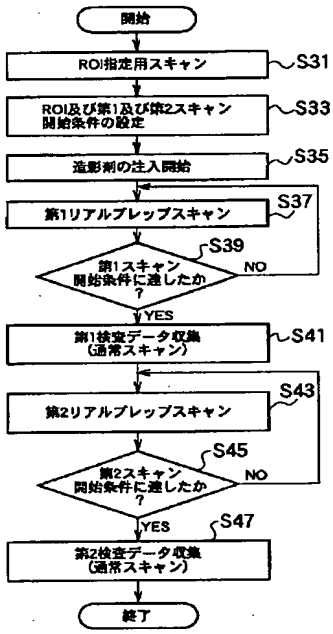
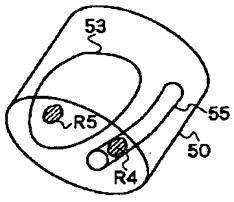
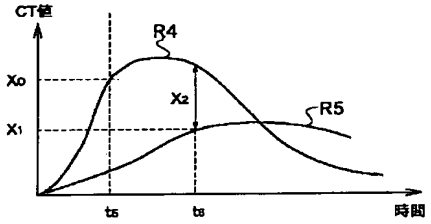


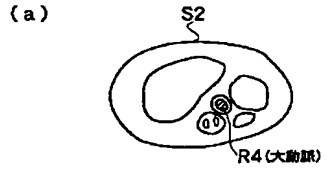
【図９】



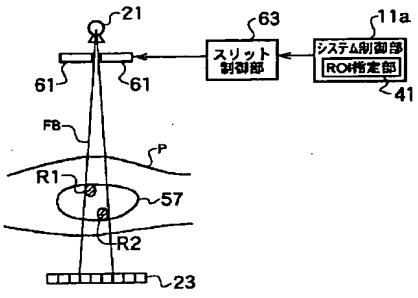
【図１０】



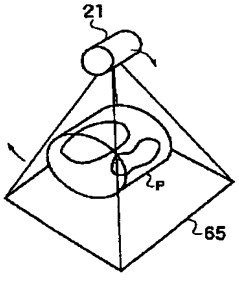
【図１１】

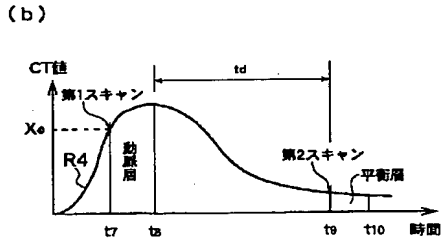


【図１３】



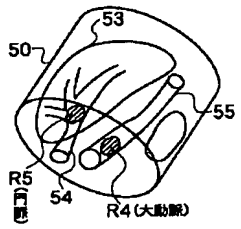
【図１４】



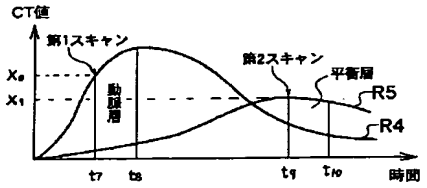


【図１２】

(a)



(b)



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